Paper No. 24

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte DONALD C. D. CHANG, KAR W. YUNG,
JOHN I. NOVAK III and ROBERT R. HOLDEN

Appeal No. 2000-2085
Application No. 08/803,937

ON BRIEF

Before FRANKFORT, McQUADE and BAHR, Administrative Patent Judges.

McQUADE, Administrative Patent Judge.

DECISION ON APPEAL

Donald C. D. Chang et al. appeal from the final rejection of claims 1, 3, 4, 6 through 10 and 14 through 19, all of the claims pending in the application.

THE INVENTION

The invention relates to a method and system for determining the position of an object such as an aircraft. Claims 1 and 8 are representative and read as follows:

1. A method for determining a position of an object utilizing two-way ranging among a plurality of satellites at known locations in communication with a ground station, the method comprising:

transmitting a first ranging signal from a first satellite in a first orbit at a first known location to the object as directed by the ground station;

transmitting a second ranging signal from the object to the first satellite in response to the first ranging signal for receipt by the ground station;

transmitting a third ranging signal from one of the first satellite and a second satellite in a second orbit at a second known location to the object as directed by the ground station;

transmitting a fourth ranging signal from the object to the other one of the first satellite and the second satellite in response to the third ranging signal for receipt by the ground station;

determining a first delay corresponding to a time difference between transmission of the first ranging signal and receipt of the second ranging signal;

determining a second delay corresponding to a time difference between transmission of the third ranging signal and receipt of the fourth ranging signal; and

determining the position of the object based on the first and second known locations of the first and second satellites, respectively, and the first and second delays.

8. A system for determining a position of an object utilizing two-way ranging among a plurality of satellites at known locations in communication with a ground station, the system comprising:

a first satellite communication transceiver in a first orbit at a first known location for providing a bidirectional communication path between the first satellite communication transceiver and the object wherein the first satellite communication transceiver transmits a first ranging signal to the object as directed by the ground station and wherein the object transmits a second ranging signal to the first satellite communication transceiver in response to the first ranging signal, and the first satellite communication transceiver further for providing a first unidirectional communication path between the first satellite communication transceiver and the object corresponding to the first satellite communication transceiver performing one of transmitting a third ranging signal to the object and receiving a fourth ranging signal from the object;

a second satellite communication transceiver in a second orbit at a second known location for providing a second unidirectional communication path between the second satellite communication transceiver and the object corresponding to the second satellite communication transceiver performing one of receiving the fourth ranging signal from the object in response to the first satellite communication transceiver transmitting the third ranging signal to the object and transmitting the third ranging signal to the object wherein the object transmits the fourth ranging signal in response thereto to the first satellite communication transceiver; and

a ground station for determining a first path length corresponding to a first time length of the bidirectional communication path, determining a second path length corresponding to a second time length of the first and second unidirectional communication paths, and determining the position of the object based on the first and second known locations and the first and second path lengths.

THE PRIOR ART

The reference relied upon by the examiner as evidence of anticipation and obviousness is:

Ames et al. (Ames) 5,126,748 Jun. 30, 1992

THE REJECTIONS

Claims 1, 8 and 10 stand rejected under 35 U.S.C. § 102(b) as being anticipated by, and in the alternative under 35 U.S.C. § 103(a) as being unpatentable over, Ames.

Claims 3, 4, 6, 7, 9 and 14 through 19 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Ames.

Attention is directed to the appellants' main and reply briefs (Paper Nos. 20 and 22) and to the examiner's final rejection and answer (Paper Nos. 15 and 21) for the respective positions of the appellants and the examiner with regard to the merits of these rejections.

DISCUSSION

Ames discloses a dual satellite navigation system and method for determining the position of a mobile object such as an aircraft 12'. The system includes a fixed ground station 10, a primary satellite S1 and a secondary satellite S2. As described by Ames, and with particular reference to Figure 2,

> ground station [10] continuously transmits two radio signals [20a, 20b'; 22a, 22b'], each with an identical periodic carrier modulation, via

each of the satellites [S1, S2] to the object being located. The object is typically a mobile unit or other vehicle such as an aircraft [12'] having a communications terminal. The fixed ground station signals, as transmitted to the object, are referred to herein as forward signals. The object receives these periodic forward signals and measures the percent of periodic phase offset between the two carrier waveforms. The difference in phase between these two carrier waveforms is due to one of the signals traveling a longer path length via one satellite than the other. The object transmits a return signal [24'[1], 24b], after some arbitrary delay in which the amount [of] the delay is not important nor required to be known, containing the percent offset information. The return signal is transmitted upon the same path as the forward signal from the first satellite, back to the fixed ground station.

In monitoring the received carrier periodic signal through the first satellite, the object performs functions that slave the clock standard of the object to the reception of the periodic signal. Thus the object clock standard is offset in time from the fixed ground station transmitted signal on account of the signal propagation delay. The object is then allowed to transmit the observed percent offset between the two forward signals, starting at some specific period in the future. The fixed ground station then receives the return signal back through the first satellite whenever it comes back, but realizes the receipt of a message starting with that specific period identification number, or frame, has arrived later than the current period being sent out on

[1] According to the Ames specification, reference numeral 24’ in Figure 2 should be 24a’.

> the forward carriers. The amount of this late arrival is interpreted as the instantaneous round trip delay of signals traveling a path from the fixed ground station to the object, and back, through the first satellite.
> . . .
> Given this round trip delay, the known velocity of propagation of the radio signal and the known distance from the fixed station to the first satellite, the distance from the first satellite to the object is calculated. The distance from the object to the second satellite is calculated from the percent difference in forward signal phase offset at the object, the round trip delay through the first satellite, the known velocity of propagation of the radio signal and the distance from the second satellite to the fixed station. Thus, the method of the present invention determines the distance from each of the satellites to the object whose position is to be determined.
> With the positions of the satellites known relative to the center of the earth, and the distances from the respective satellites to the object whose position is to be determined are known, trilateration may be employed to determine the position of the object relative to the center of the earth and the satellites [column 3, line 52, through column 4, line 66].

In comparing the method and system recited in independent claims 1 and 8, respectively, to the method and system disclosed by Ames, the examiner (see pages 2 and 3 in the final rejection) has read the claim limitations relating to the second and fourth ranging signals on Ames’ return link signal 24'. The examiner’s rationale here (see pages 3 and 4 in the answer) is that signal 24' effectively constitutes both a second ranging signal and a fourth ranging signal as recited in claims 1 and 8 because it serves the respective purposes of the second and fourth ranging signals in determining first and second delays (claim 1) or time lengths (claim 8) used to ultimately determine the position of the object. While the examiner’s finding that Ames’ signal 24' has this dual purpose is arguably sound, the fact remains that signal 24' is but a single signal. As such, it conceivably meets the claim limitations relating to either the second ranging signal or the fourth ranging signal, but not both. Moreover, there is nothing in the teachings of Ames which would have suggested replacing signal 24' with two signals. Thus, the examiner’s conclusion that the subject matter recited in claims 1 and

8, and in dependent claims 3, 4, 6, 7, 9, 10 and 14 through 19, is anticipated and/or rendered obvious by

Ames is not well founded.

Accordingly, we shall not sustain any of the examiner’s rejections.

SUMMARY

The decision of the examiner to reject claims 1, 3, 4, 6 through 10 and 14 through 19 is reversed.

REVERSED

CHARLES E. FRANKFORT)
Administrative Patent Judge)
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